

Perinatal and Infant Health Outcomes among Neonates Born to Aboriginal Parents in Taiwan

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Background: Poor health outcomes among neonates born to aborigines has been reported in many countries. This study was aimed to examine the nationwide characteristics of live births, adverse birth outcomes, and age-specific mortality among neonates born to non-aboriginal and aboriginal parents in Taiwan.

Methods: All neonates born alive during the period of 2000 to 2003 in Taiwan were included. The adverse birth outcomes including low birth weight, preterm, and small-for-gestational-age births, and age-specific mortality were obtained. Logistic regression analysis was used to estimate odds ratios for parental ethnicity in relation to birth outcomes, while Cox's proportional hazards regression models were used to estimate hazard ratios for parental ethnicity in relation to age-specific infant deaths.

Results: A total of 947,317 live births were included that consisted of 9,381 born to aboriginal mothers, 6,429 born to aboriginal fathers, and 15,354 born to aboriginal parents. There was a gradual increase in the risk of having a baby with low birth weight, preterm, or small for gestational age born to the four parental aboriginal ethnicity groups: non-aboriginal parents, aboriginal mother only, aboriginal father only, and aboriginal parents. Similar trends were also found for early neonatal, neonatal, and infant mortalities after stratification of residential areas. The neonates born to both aboriginal parents with residence in rural or mountain areas were at highest risk of adverse birth outcomes and age-specific mortality.

Conclusions: Our results demonstrated that aboriginality and residential area are important risk factors for adverse perinatal and infant outcomes. (*Acta Paediatr Tw* 2007; **48**:135-40)

Key words: perinatal outcome, infant outcome, aborigines

INTRODUCTION

Poor perinatal and infant outcomes among aborigines have been reported in many countries.¹⁻⁶ Aboriginality used to be considered as a risk factor, but this concept has been challenged. Previous studies reported that aboriginality per se may lose its association with adverse outcomes after adjusting the confounding factors.^{7,8} Their

results may be questionable due to relative smaller sample size and inappropriate patient selection based on a single hospital study. In addition to aboriginality, other factors including poorer socioeconomic status and malnutrition, and health-damaging behaviors such as smoking and alcohol drinking, may also contribute to the adverse outcomes.⁷⁻¹¹

The aborigines in Taiwan had been previously reported

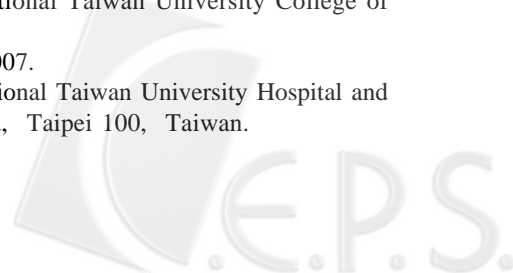
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to have lower life expectancy, higher infant mortality, and higher morbidity rates associated with many health problems.^{12,13} However, after the implementation of the National Health Insurance (NHI) in Taiwan since 1995, the people in Taiwan including the aborigines have received medical care conveniently and universally.¹⁴ NHI provides pregnant women with regular prenatal and intrapartum care services. In addition, it also provides follow-up neonatal care service and the nationwide vaccination programs for pediatric population.¹⁴⁻¹⁶ Improvement of the medical care in aboriginal areas has been considered to be one of NHI's best achievements. Despite the utilization of the services by aboriginal pregnant women having increased, utilization of the neonatal care service may have regional difference, especially in the rural or mountain areas.¹⁴⁻¹⁶ Lower NHI coverage rate and difficulties in access to medical resources due to traveling time and traveling distance are problems in aboriginal health care.¹⁷

This study was aimed to illustrate the characteristics of live births, adverse birth outcomes, and age-specific mortality among neonates born to non-aborigines and aboriginal parents in Taiwan. We also analyzed the impact of residency on perinatal and infant health outcome in aborigines based on a nationwide database.

MATERIALS AND METHODS

Data sources

We used the birth certificate registration data with the information of birth outcomes and potential risk factors from the Ministry of Interior in Taiwan. The Children Welfare Act¹⁸ mandates birth registration by an obstetrician or midwife within 10 days for live births for which work has been implemented since October of 1994. The certificate form contains child and parental information. The former include parental indigenes, national identification number, date of birth, education, marital status, and residence. The latter include neonatal identification number, date of birth, birth weight, gestational age, parity, singleton or multiple births, delivery institute, and the information on obstetrician or midwife.

Death certificate registration data is maintained by the Department of Health in Taiwan. The death certificate information has been computerized since 1971 in Taiwan consists of national identification number, dates of birth and death, education, residency, and cause of death. The cause of death is systematically coded according to the ninth revision of the International Classification of Diseases (ICD-9).

Study population

There were a total of 1,017,257 live births registered between 2000 and 2003 in Taiwan. After excluding births to parents with missing ethnicity data (20,633, 2.0%) and those with missing data in covariates (49,307, 4.8%), a total of 947,317 live births were included for analysis. Then, each neonatal identification number was linked to the death certificate registration data. This study was approved by the National Taiwan University College of Public Health Ethics Review Board, Taipei, Taiwan.

Definitions of birth outcomes and infant deaths

Low birth weight refers to babies with birth weight below 2,500 g and preterm as babies born before 37 completed weeks (259 days) of gestation, as measured from the first day of the last menstrual period. Small for gestational age is defined as birth weight falling below the 10th percentile of the appropriate gestation age-specific birth weight distribution in Taiwan.¹⁹ Neonatal deaths refer to deaths that occurred during the first 28 days of life. They are subdivided into early neonatal deaths, occurring during the first seven days of life, and late neonatal deaths, occurring from the seventh through the 28th day of life. Postneonatal deaths refer to deaths after the 28 completed days through the first year of life, while infant deaths refer to deaths during the first year of life.²⁰

Statistical analyses

Logistic regression models were used to estimate crude and adjusted odds ratios (ORs) and their 95% confidence intervals (CIs) of adverse birth outcomes according to parental indigenes (plain or mountain indigenes and others), while Cox's proportional hazards regression models were used to estimate crude and adjusted hazard ratios (HRs) and their 95% CIs for age-specific mortalities. Several risk factors of adverse birth outcomes and infant mortalities, which potentially modify or confound the relationship between parental ethnicity and adverse birth outcomes and infant mortalities, were examined and controlled. Marital status (married and unmarried), maternal age (<20, 20-24, 25-29, 30-34, and ≥ 35 y), paternal age (<25, 25-29, 30-34, 35-39, and ≥ 40 y), parental education (≤ 6 , 7-9, 10-12, and ≥ 13 y), residential area (urban, suburban, rural, and mountain), parity (primipara and multipara), infant sex (male and female), and plurality (singleton, twin and triplet) were taken into account in the models for low birth weight and preterm births and age-specific infant mortalities. However, infant sex was not entered into the models for small for gestational age births. All statistical analyses were performed using SAS software 8.0.



RESULTS

Table 1 shows characteristics of live births according to parental aboriginal ethnicity: neither (n = 916,153), mother only (n = 9,381), father only (n = 6,429), and both (n = 15,354). Comparing to non-aboriginal parents, aboriginal parents were younger, of lower educational levels, and more multiparous. A higher proportion of them gave births in unmarried status and resided in rural or mountain areas. There were fewer twin and triplet babies born to paternal aborigines and aboriginal parents

than to non-aboriginal parents and maternal aborigines.

Table 2 shows adverse birth outcomes and age-specific infant mortalities of live births according to their parental aboriginal ethnicity. There was a gradual increase in low birth weight and small-for-gestational-age babies born to the four parental aboriginal ethnicity groups: non-aboriginal parents, aboriginal mother only, aboriginal father only and aboriginal parents, while aboriginal parents were more likely to have preterm babies than non-aboriginal parents. Similar trends were found for age-specific infant mortalities, with the exception

Table 1. Parental Characteristics, Residential Areas, and Neonatal Characteristics of Live Births according to Parental Ethnicity in Taiwan, 2000-2003

Characteristics	Parental ethnicity as aborigine				Total
	Neither	Mother	Father	Both	
Number	916,153	9,381	6,429	15,354	947,317
Maternal age (%)					
<20 y	1.6	6.4	6.3	6.6	1.8
20-24 y	17.0	29.8	29.4	31.2	17.4
25-29 y	36.4	34.0	34.4	32.2	36.3
30-34 y	32.4	20.4	20.9	19.2	32.0
≥35 y	12.6	9.3	9.0	10.7	12.5
Paternal age (%)					
<25 y	5.7	12.5	13.5	13.1	6.0
25-29 y	23.7	32.9	31.5	30.3	24.0
30-34 y	38.7	31.5	30.2	28.8	37.7
35-39 y	23.4	15.6	16.7	17.8	23.2
≥40 y	9.1	7.4	8.2	10.0	9.1
Marital status (%)					
Married	99.0	96.5	96.4	97.3	98.9
Unmarried	1.0	3.5	3.6	2.7	1.1
Maternal education (%)					
≤6 y	2.4	7.3	5.9	13.4	2.7
7-9 y	17.5	33.7	32.0	39.8	18.1
10-12 y	45.7	46.0	47.5	39.3	45.6
≥13 y	34.4	13.0	14.5	7.5	33.6
Paternal education (%)					
≤6 y	2.0	3.5	8.2	12.0	2.2
7-9 y	20.6	31.3	37.6	40.7	21.1
10-12 y	40.8	47.3	41.4	38.8	40.8
≥13 y	36.3	17.3	12.2	8.1	35.5
Residential area (%)					
Urban or suburban	70.8	61.1	47.3	26.5	69.8
Rural or mountain	29.2	38.9	52.7	73.5	30.2
Parity (%)					
Primipara	48.4	42.9	44.1	32.1	48.1
Multipara	51.4	56.8	55.5	67.0	51.8
Infant sex (%)					
Male	52.3	53.0	52.6	51.7	52.3
Female	47.7	47.0	47.4	48.3	47.7
Plurality (%)					
Singleton	97.4	97.3	98.4	98.2	97.4
Twin or triplet	2.6	2.7	1.6	1.8	2.6

of late neonatal and postneonatal mortalities.

Table 3 shows adjusted odds ratios for adverse birth outcomes and age-specific infant mortalities of live births according to their parental aboriginal ethnicity. There was a gradual increase in the risk of having a baby with low birth weight, preterm, or small for gestational age born to the four parental aboriginal ethnicity groups: non-aboriginal parents, aboriginal mother only, aboriginal father only, and aboriginal parents. Similar trends were noted for early neonatal, neonatal, and infant mortalities, and the results remained the same even after stratification of residential areas (Table 4).

DISCUSSION

Health care among aboriginal pregnant women and their newborn infants are important public health issues around the world. The current study explored the perinatal characters among Taiwanese aboriginal parents to identify

the contributing factors to perinatal outcomes. Like other aborigines around the world, the aboriginal women in Taiwan suffer from similar problems, i.e., more teenage pregnancy, less education, and more unmarried status.^{3,4,7,21} The teenager pregnancy ratio of Taiwanese aborigines was similar to those of American Indians and Alaska natives, and yet was lower than those of Canadian Inuits and Indians, and of Australian aborigines.^{3,4,7} The ratio of school attainment more than thirteen years in aboriginal mothers was highest in the US, but it was lower in Taiwan and in Canada.^{3,4} The ratio of single aboriginal mothers was lowest in Taiwan.

The relative disparities between aboriginal and non-aboriginal women changed little over recent decades in Western countries, although the absolute rate differences diminished substantially.^{3,4,7,8} Compared to other North American women, aboriginal women experience poorer birth outcomes, such as higher rates of stillbirth, prematurity and low-birth-weight infants.⁷ The higher risks of adverse pregnancy outcomes among

Table 2. Adverse Birth Outcomes and Age-specific Infant Mortalities of Live Births according to Parental Ethnicity in Taiwan, 2000-2003

Infant health	Parental ethnicity as aborigine				Total
	Neither	Mother	Father	Both	
Number	916,153	9,381	6,429	15,354	947,317
Adverse birth outcome (%)					
Low birth weight	6.86	8.60	8.68	11.70	6.97
Preterm	7.99	10.02	9.70	11.96	8.09
Small for gestational age	9.21	10.29	11.31	14.48	9.32
Age-specific mortality (‰)					
Early neonatal mortality	2.13	3.09	3.58	4.75	2.19
Late neonatal mortality	0.89	0.64	0.62	1.43	0.90
Neonatal mortality	3.02	3.73	4.20	6.19	3.08
Postneonatal mortality	2.16	1.60	4.82	5.34	2.23
Infant mortality	5.18	5.33	9.02	11.53	5.31

Table 3. Adjusted Odds Ratios for Adverse Birth Outcomes and Hazard Ratios for Age-specific Infant Mortalities of Live Births according to Parental Ethnicity in Taiwan, 2000-2003

Infant health	Parental ethnicity as aborigine			
	Neither	Mother	Father	Both
Adverse birth outcome	Adjusted odds ratio (95% CI)			
Low birth weight*	1.00	1.17 (1.08-1.26)	1.27 (1.16-1.40)	1.76 (1.67-1.86)
Preterm*	1.00	1.20 (1.12-1.29)	1.24 (1.14-1.35)	1.49 (1.42-1.57)
Small for gestational age†	1.00	0.99 (0.93-1.06)	1.08 (1.00-1.17)	1.46 (1.40-1.53)
Age-specific mortality	Adjusted hazard ratio (95% CI)			
Early neonatal mortality*	1.00	1.35 (0.94-1.96)	1.66 (1.10-2.50)	2.11 (1.66-2.68)
Neonatal mortality*	1.00	1.14 (0.81-1.59)	1.34 (0.92-1.97)	1.89 (1.53-2.33)
Infant mortality*	1.00	0.89 (0.67-1.17)	1.55 (1.19-2.01)	1.85 (1.59-2.16)

Abbreviations: CI, confidence interval.

* Adjusted for marital status, parental ages, parental educations, parity, infant sex, and plurality.

† Adjusted for marital status, parental ages, parental educations, parity, and plurality.

Table 4. Adjusted Odds Ratios for Adverse Birth Outcomes and Hazard Ratios for Age-specific Infant Mortalities of Live Births according to Parental Ethnicity and Residential Area in Taiwan, 2000-2003

Infant health	Urban and suburban				Rural and mountain			
	Parental ethnicity as Aborigine				Parental ethnicity as Aborigine			
	Neither	Mother	Father	Both	Neither	Mother	Father	Both
Adverse birth outcome	Adjusted odds ratio (95% CI)							
Low birth weight*	1.00	1.06 (0.96-1.18)	1.20 (1.04-1.37)	1.58 (1.42-1.76)	1.02 (1.00-1.04)	1.36 (1.21-1.52)	1.36 (1.20-1.53)	1.84 (1.74-1.96)
Preterm*	1.00	1.23 (1.12-1.34)	1.18 (1.04-1.34)	1.53 (1.39-1.69)	1.03 (1.02-1.05)	1.20 (1.07-1.34)	1.32 (1.17-1.34)	1.51 (1.42-1.60)
Small for gestational age†	1.00	0.98 (0.89-1.06)	1.02 (0.91-1.15)	1.21 (1.09-1.33)	1.01 (0.99-1.02)	1.03 (0.93-1.15)	1.14 (1.03-1.27)	1.56 (1.48-1.65)
Age-specific mortality	Adjusted hazard ratio (95% CI)							
Early neonatal mortality*	1.00	1.35 (0.84-2.19)	1.28 (0.64-2.56)	2.07 (1.31-3.27)	1.13 (1.03-1.25)	1.52 (0.86-2.68)	2.15 (1.29-3.58)	2.27 (1.72-3.00)
Neonatal mortality*	1.00	1.20 (0.79-1.82)	0.98 (0.51-1.88)	1.77 (1.18-2.66)	1.07 (0.98-1.16)	1.11 (0.64-1.92)	1.73 (1.09-2.76)	2.00 (1.57-2.55)
Infant mortality*	1.00	0.89 (0.62-1.28)	1.11 (0.71-1.75)	1.57 (1.15-2.15)	1.04 (0.97-1.10)	0.90 (0.58-1.41)	1.96 (1.43-2.69)	1.99 (1.67-2.38)

* Adjusted for marital status, parental ages, parental educations, parity, infant sex, and plurality.

† Adjusted for marital status, parental ages, parental educations, parity, and plurality.

aboriginal women are thought to be partly attributed to their disadvantaged socioeconomic status. The high prevalence of smoking, poor nutrition, a previous premature infant and bacterial vaginosis in midgestation in these mothers may also contribute the adverse perinatal outcomes.⁷ In addition, there were much higher risks of infant death resulting from sudden infant death and infections among both Inuit and Indian infants.^{3,7} We found that neonates born to aboriginal parents in Taiwan had higher prevalence rates of preterm, low birth weight, and small-for-gestational-age births. Except for late neonatal mortality rate, these infants had unfavorable neonatal and infant outcomes, too. After adjusting for the confounding factors such as parental ages, education, marital status, parity, infant sex, and plurality, the neonates born to aboriginal parents suffered from the highest risk of adverse birth outcomes and age-specific mortality (Table 3). The causes of death in early neonatal, neonatal and infant mortality were similar among four different groups in our study. Perinatal events such as low birth weight and immaturity-related neonatal death and congenital anomaly mainly contributed to increased early neonatal mortalities; accident and injury events are important causes of postneonatal mortality (data not shown). Both maternal and perinatal factors may together contribute to the adverse perinatal and infant outcomes in our study. These results suggest an urgent need to improve access to and quality of obstetric and perinatal care among aborigines. The adverse health outcomes

among the neonates born to aboriginal father may attribute to poorer socioeconomic status. Further improvement in socioeconomic conditions among aborigines is also mandated in Taiwan.

Residential factor may play an important role in the prevalence of perinatal and infant outcomes. Baldwin et al. found that receipt of an inadequate pattern of prenatal care was significantly higher for rural than for urban mothers of American Indians and Alaska Native infants.⁴ Rates of inadequate prenatal care in both groups were over twice than that for Whites. The post neonatal death rates among American Indians and Alaska Native infants were also more than twice that of Whites. They suggested that this situation may be due to the interference with women's receipt of prenatal care by some barriers such as greater distances from health services, and limited transportation systems in rural areas. Similarly, the neonates born to parents residing in rural or mountain areas suffered from higher risks of adverse birth outcomes and age-specific mortality than those of parents residing in urban or suburban areas, in our study. In addition, the neonates born to aboriginal parents residing in rural or mountain areas were associated with the highest risk of adverse birth outcomes and age-specific mortality. Nevertheless, the neonates born to maternal aborigines only showed similar outcome in late neonatal and postneonatal mortalities compared to the infants born to non-aboriginal parents. Furthermore, the risks for adverse birth outcomes such as small for gestational age

and infant mortality were also comparable between groups. Except for the similar ratio of residency in urban and suburban areas, factors that may contribute to these favorable birth outcomes require more investigation.

Several limitations in our study design merit consideration. First, we used the nationwide database that included incomplete socioeconomic information. This may affect the adverse birth and neonatal outcomes. Second, some aboriginal cultures and practices such as smoking, alcohol drinking, and betel nut chewing that may affect these outcomes were not analyzed in this study. Third, the causes of deaths could not be specified due to coding limitation. Finally, we tested several outcomes or mortalities and, then, may inflate type I errors. This would not have a significant impact on our findings about the biologically related outcomes and their consequent mortalities. However, this study was the first to analyze the nationwide database on birth outcomes and age-specific infant mortalities among the aborigines and the non-aborigines in Taiwan.

In conclusion, this study has provided important information on the perinatal and infant health outcomes among neonates born to aboriginal parents in Taiwan. Improvement of obstetric care and a reduction in preterm births is necessary to enhance perinatal and infant health outcomes among the aborigines. The government should also provide more evenly distributed medical and educational resources, and convenient transport systems, especially in the rural and mountain areas. Furthermore, public health policies for improvement in healthier lifestyle such as decreasing smoking habit, alcohol consumption, substance abuse, and prevention of accident events, sudden infant death and infection-related deaths are also important to improve health outcomes for the aborigines.

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